Analysis charging/battery Levo MJ 2019

Version 0.1, 27.12.2018

All information without guarantee!!! All attempts at your own risk!!!

Only experts should attempt to connect the Levo's power supply!!! There is a risk of fire and therefore danger to life!!!

Test setup

- Y-cable with Rosenberger PD connectors
- USB-CAN V7.00 ANALYZER from SeeedStudio/Antratek
- SeeedStudio Can Analyzer Software

Wiring and logic

Battery charging socket:

Start charging:

- All potentials are measured against the negative pole of the battery.
- The battery is "woken up" by a control voltage of 5 volts on the brown cable and then switches its battery voltage to "red" and "black". If this is the case, the charging process can be started. The output of the original charger appears to have a relatively high resistance (protective resistor), the voltage settles at around 2.4 volts during operation.
- The orange auxiliary power connection on the Rosenberg Power Data Connector carries 12 volts when the battery has been "woken up". This comes from the battery and not from the charger.

- The charging process starts even if the charger is not connected to the CAN bus (CAN lines disconnected). All CAN messages come from the battery. The charger does not send anything via the CAN bus. The termination of the CAN bus did not have to be activated on the USB monitor adapter. The battery appears to have suitable resistors.
- The battery only sends CAN messages when a charging current flows.

Further observations:

- The effect described for the Bosch charger, that the battery voltage is temporarily switched off during the charging process, could not be observed with the Levo (see https://www.pedelecforum.de/forum/index.php?threads/classic-bosch-ladeger%C3%A4t-akkulade Behavior.12896/page-6)
- A Junsi charger 4010 was basically able to charge the battery.**However, a full charge was not tested**The behavior of the BMS built into the battery was not investigated. The charging program (LiPo) was set to 42 volt cut-off voltage (10 cells) without balancing and 2A charging current.
- In the above-mentioned thread of the Pedelec forum, post #111 reported that the BMS system of another manufacturer was destroyed by a model charger (unknown reason). So be careful here. Only those who know what they are doing should take action here.

Battery CAN bus messages

The battery sends messages as soon as a certain charging current flows. It seems as if the CAN frame IDs starting from 0x400 are used by the battery (0x400, 0x401, 0x402, 0x403).

CanOpen

https://en.wikipedia.org/wiki/CANopen

The Levo uses**NO**CanOpen!!!

Trace extracts

Data is basically "Little Endian", i.e.a1 f e n eis 0xFFFFFEA1. Current, voltage and capacity values   are usually " times 1000".

71 percent battery voltage:

00000401	8	| b0 9a |00 00|a1 fe|ff ff	39.6V	
00000400	8	00 00 8c 80 00 00 00 00		
00000401	8	b0 9a 00 00 a1 fe ff ff		
00000400	8	00 00 8c 80 00 00 00 00		
00000401	8	b0 9a 00 00 a1 fe ff ff		
00000400	8	00 00 8c 80 00 00 00 00		
00000401	8	b0 9a 00 00 fa fd ff ff		
00000400	8	00 00 8c 80 00 00 00 00		
00000401	8	b2 9a 00 00 fa fd ff ff		
00000400	8	00 00 8c 80 00 00 00 00		
00000402	8	46 00 00 00 28 d9 04 00	317Wh corresponds to 63% - *1.12=70.56% (see below)	
00000401	8	b2 9a 00 00 fa fd ff ff		
00000400	8	00 00 8c 80 00 00 00 00		
00000401	8	b0 9a 00 00 fa fd ff ff		

23 percent battery voltage (measured 35.5V):

00000400	8	00 00 8c 80 00 00 00 00		
00000 **401**	8	| d3 8a | 00 00 | 03 fb | ff ff	35.5V	
00000400	8	00 00 8c 80 00 00 00 00		
00000401	8	d3 8a 00 00 03 ee ff ff		
00000400	8	00 00 8c 80 00 00 00 00		
00000401	8	d3 8a 00 00 f8 fd ff ff		
00000400	8	00 00 8c 80 00 00 00 00		
00000401	8	d5 8a 00 00 f8 fd ff ff		
00000400	8	00 00 8c 80 00 00 00 00		
00000402	8	16 00 00 00 24 8c 01 00 22 %	101Wh ???	=20% - *1.12=22.44%
00000401	8	d5 8a 00 00 f8 fd ff ff		
00000400	8	00 00 8c 80 00 00 00 00		
00000401	8	d3 8a 00 00 f8 fd ff ff		
00000400	8	00 00 8c 80 00 00 00 00		
00000401	8	d3 8a 00 00 f8 fd ff ff		
00000400	8	00 00 8c 80 00 00 00 00		

interpretation

ID 401: Battery

23%

00000 **401**	8	| d3 8a | 00 00 | 03 f | ff ff	35.5V	- 0.509A
...				
00000401	8	09 8d 00 00 | 58 f0 | ff ff	36.1V	- 4.008A

71%

00000401	8	b0 9a 00 00 | a1 f | ff ff	39.6V	- 0.351A
...				
00000401	8	2a 9d 00 00 | 62 f0 | ff ff	40.2V	- 0.3998A

23-35%:

19:01:53:823	00000401	8	10 8b 00 00 5a e f f f		
19:02:30:184	00000401	8	a6 8d 00 00 5b f0 ff ff	36.2V (35.43)	- 4.005A
19:03:30:143	00000401	8	52 8e 00 00 5c f0 ff ff 00 00 5a	36.4V (36.25)	
19:05:30:773	00000401	8	22 8f f0 ff ff 00 00 55 f0 ff ff	36.6V (36.51)	
19:09:30:048	00000401	8	31 90 00 00 52 f0 ff ff 00 00	36.9V (36.71)	
19:12:30:477	00000401	8	c6 90 52 f0 ff ff 00 00 4f f0 ff	37.1V (36.90)	
19:14:30:716	00000401	8	1d 91 ff 00 00 4d f0 ff ff	37.1V (37.00)	
19:19:30:854	00000401	8	db 91	37.3V (37.20)	
19:22:30:955	00000401	8	4a 92	37.4V (37.30)	

First word low/hi: Current   Tension , here 35.5V (23%) and 39.6V (71%) , divided by 1,000.

Second word: Always 0

Third and fourth words: charging current negative (2's complement) divided by 1,000.

ID 400: Battery

Second word: Unclear, possibly minimum voltage ??? 0x808c = 32.9 V

| 00000400 | 8 | 00 00 | 8c 80 | 00 00 00 00 |

...

| 00000400 | 8 | 00 00 8c 80 00 00 00 00 |

Always constant

ID 402: Battery

First word/byte: Charging status in   percent ?

Third word and fourth word: Energy Amount DWORD   ???

23% (22%):

| 00000402 | 8 | 16 00 00 00 | 24 8c 01 00 | 22% | 101Wh | ??? |

...

| 00000402 | 8 | 16 00 00 00 64 8e 01 00 | 22% |

71% (70%):

| 00000402 | 8 | 46 00 00 00 28 d9 04 00 |

...

| 00000402 | 8 | 46 00 00 00 | 68dB 04 00 | 318Wh | ??? |

...

| 00000402 | 8 | 46 00 00 00 b0 db 04 00 |

23-35%:

| 00000402 | 8 | 17 00 00 00 | 40 97 01 00 | 23% | 104Wh | ??? (20.8%) |

...

| 00000402 | 8 | 22 00 00 00 | 74 59 02 00 | 35% | 153Wh | ??? (30.6%) BlEvo:174Wh at 504W |

To calculate the correct amount of energy, see assumption below

ID 403: Battery

PDO, Node ID: 1, RTR 1

| 00000403 | 8 | 64 00 00 00 | d0 dd 06 00 | | 450Wh | ??? Maximum capacity ?? |

Always constant

Assumption (!) regarding energy quantity/capacity

The 403 message sets the maximum capacity to 450Wh instead of 504Wh. The capacity value from the 402 message must therefore be multiplied by a factor of 1.12 (=504Wh/450Wh)

BLEvo shows, for example, 174Wh with a measured value of 153Wh - times 1.12 - 171 Wh.